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PLANTING AND
CARE OF SHELTER
BELTS ON THE
NORTHERN
GREAT PLAINS



PLANTING AND CARE OF SHELTER BELTS ON THE NORTHERN GREAT PLAINS

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INTRODUCTION

THE PURPOSE of this bulletin is to describe methods of planting and caring for trees in shelter belts on the northern Great Plains that have been found successful by the United States Department of Agriculture. These methods have been worked out by the Northern Great Plains Field Station, Mandan, N. Dak., through investigations conducted in the Plains section of North Dakota, South Dakota, Montana, and Wyoming.

To show the possibilities of tree planting in this area, a cooperative shelter-belt demonstration project was started in 1916. The main objects of the project have been to stimulate interest in the improvement of farm homes by the planting of belts of trees near the farm buildings and to determine by actual trial the kinds of trees best suited to the different sections and the best methods of handling them. A limited number of farmers each year have been supplied with trees to be planted and cared for in accordance with plans and instructions furnished by the Department of Agriculture. At the end of 1928 nearly 2,000 shelter belts, varying in age from 1 to 18 years, had been established. The methods described in this bulletin are based on studies of this large number of farm plantings at different periods of their growth.

The important items to be considered by the prospective tree planter are as follows: (1) The plan of the shelter belt, (2) the preparation of the soil before planting, (3) the method of planting the trees, and (4) the cultivation and protection of the trees after planting.

SHELTER-BELT PLANS

Before a detailed plan for a shelter belt can be made, it is necessary to decide on the location and size of the planting site, the spacing distances to be used in setting out the trees, and the kinds and sizes of trees to be planted. Figure 1 shows a typical shelter-belt plan embodying the principles set forth in the following paragraphs. This plan must ordinarily be modified in details to fit the actual conditions existing on a given farm.

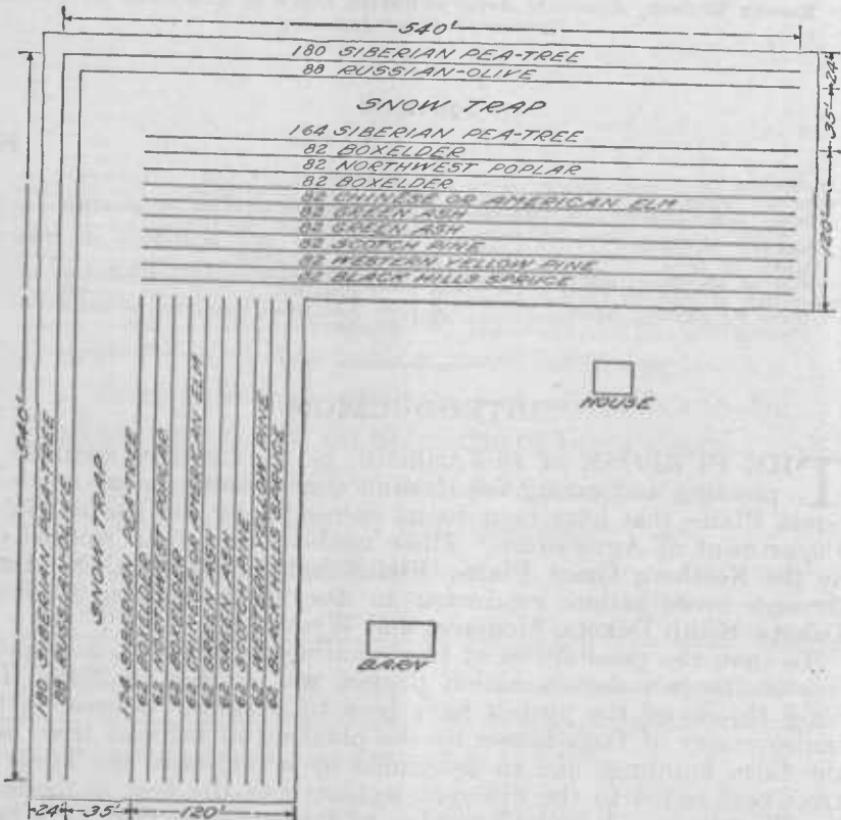


FIGURE 1.—Typical shelter-belt planting plan. Rows 12 feet apart. Siberian pea-trees 3 feet apart in the row; all other species 6 feet apart in the row. Trees required: Siberian pea-tree, 648; Russian olive, 176; boxelder, 288; northwest poplar, 144; Chinese elm or American elm, 144; green ash, 288; Scotch pine, 144; western yellow pine, 144; and Black Hills spruce, 144.

SIZE AND LOCATION OF SHELTER BELTS

SHELTER FOR BUILDINGS AND YARDS

Winter protection is the important consideration in locating a shelter belt for buildings and yards. As winter storms on the northern Great Plains usually come from a northwesterly direction, the shelter belt should be placed north and west of the buildings, so as to form a belt of uniform width in the shape of a right angle. If the buildings are so located that it is not feasible to plant trees on

two sides, the shelter belt may be laid out as a single strip on either the north or the west side.

A space of 50 to 100 feet ordinarily should be allowed between buildings and the inside edge of the shelter belt.

Where sufficient land is available, the planting should be from 100 to 200 feet wide, so that it may include a snow trap, as illustrated in Figure 2. If the width of the planting is less than 100 feet, it is probably best to plant a solid belt without a snow trap.

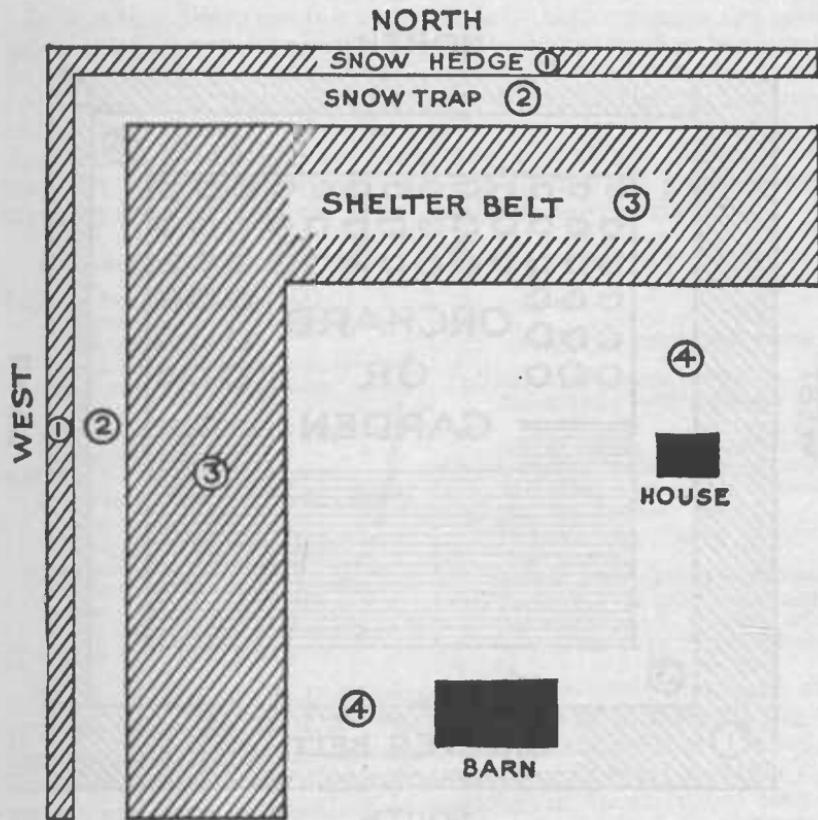


FIGURE 2.—Plan of a shelter belt recommended for buildings and yards. 1, Snow hedge, 20 to 30 feet wide; 2, snow trap, 30 to 60 feet wide; 3, shelter belt, 50 to 100 feet wide; 4, space 50 to 100 feet wide between shelter belt and buildings

SHELTER FOR ORCHARD AND GARDEN

Protection from strong winds in spring and summer is of first importance in planning the location of a shelter belt for orchard and garden. Protection is usually most needed on the west and south, although shelter on the north and east will prove of value. The width of a planting for the protection of an orchard or a garden may be somewhat less than that required for the winter protection of buildings and yards. Single rows of trees often will prove beneficial.

As trees send out their roots for some distance beyond the row in which they are actually planted, fruit trees and garden crops

should not be placed closer than 20 to 30 feet from the inside row of the shelter belt. Figure 3 illustrates the location of a shelter belt for an orchard or a garden.

SPACING DISTANCES

In a region of limited rainfall, wide spacing will favor the vigor and rate of growth of the individual tree. It is obvious, however, that a shelter belt can not be fully effective in checking the wind

NORTH

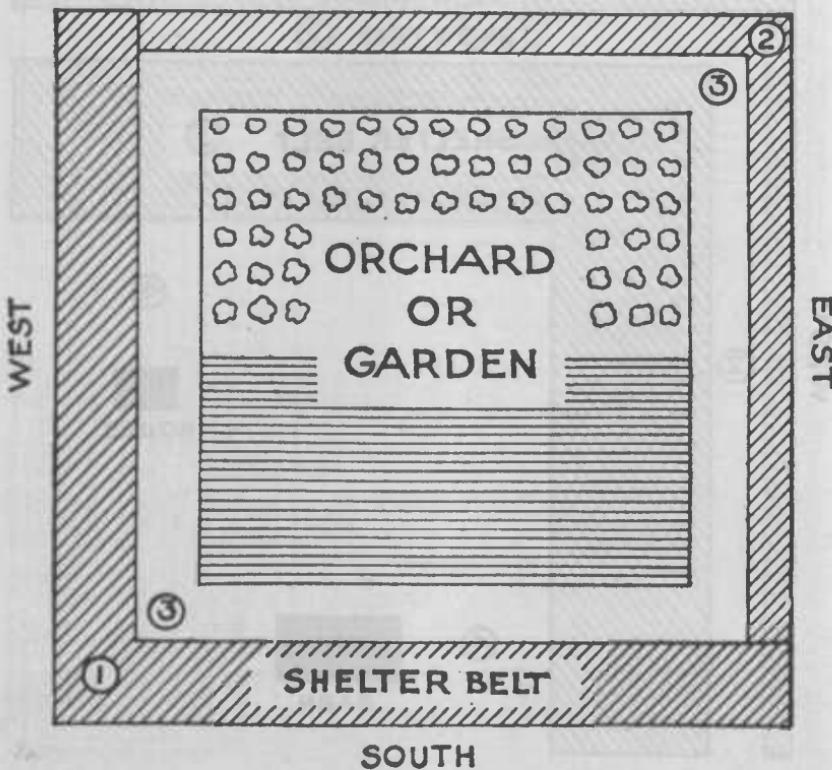


FIGURE 3.—Recommended plan of a complete shelter belt for an orchard or a garden.
1, Shelter on the west and south, of first importance; 2, shelter on the north and east, of second importance; 3, a space of at least 20 to 30 feet should be left between the shelter belt and the orchard or garden.

until the branches of the trees have grown together. It therefore seems practicable to adopt a system of spacing by which the trees are planted fairly closely together in the row, with a greater space between the rows.

A spacing distance of 6 by 10 or 6 by 12 feet is recommended, the rows to be 10 or 12 feet apart and the trees to stand 6 feet apart in the row. Siberian pea-tree and similar hedgelike types of trees should be spaced 3 feet apart in the row when planted on the edge of a shelter belt. Closer spacing, such as 4 by 8 or 4 by 4 feet, may

be used if a dense stand is desired in the shortest possible time. Unless trees so spaced are thinned at a later date, it is not likely that they will continue in a thrifty condition for so long a period as the same kinds planted 6 by 10 or 6 by 12 feet apart.

It is especially beneficial to allow space on the outside edge of the planting for a strip of cultivated soil of the same width as the full distance between the rows of trees.

KINDS OF TREES

In selecting the trees for a shelter belt, better results are usually obtained where two or more species of trees are used in combination than where only a single species is used. For the outside rows of a shelter belt, trees that will form a dense growth close to the ground are the most desirable. For the rows in the interior of the belt, trees that attain a good height are the best type to plant. Species of trees that have been found suitable for use in shelter-belt plantings on the northern Great Plains are given in the following list:

BROADLEAF OR DECIDUOUS TREES

Suitable for outside rows:

- Siberian pea-tree (*Caragana arborescens*).
- Chokecherry (*Prunus virginiana*).
- American plum (*Prunus americana*).
- Silver buffaloberry (*Leparyrea argentea*).

Suitable for interior rows:

- American elm (*Ulmus americana*).
- Green ash (*Fraxinus lanceolata*).
- Chinese elm (*Ulmus pumila*).
- Sargent cottonwood (*Populus sargenti*).
- Northwest poplar (*Populus sp.*).
- Boxelder (*Acer negundo*).

Suitable for interior rows—Continued.

- Russian-olive (*Elaeagnus angustifolia*).

CONIFER OR EVERGREEN TREES

Suitable for outside rows:

- Black Hills spruce (*Picea glauca albertiana*).
- White spruce (*Picea glauca*).
- Colorado spruce (*Picea pungens*).
- Red cedar (*Juniperus virginiana*).

Suitable for interior rows:

- Western yellow pine (*Pinus ponderosa*).
- Scotch pine (*Pinus sylvestris*).
- Jack pine (*Pinus banksiana*).
- American larch (*Larix laricina*).
- European larch (*Larix decidua*).

The species given in the foregoing list are trees that have shown promise under actual test. The list does not include all the trees that might be successfully grown on the northern Great Plains. No single species of tree will be certain to grow in every location in this region, and there is considerable variation in the ability of each kind of tree to adapt itself to all the conditions of temperature, soil, drought, and exposure that exist in an area so extensive. The tree planter should be ready to replace any of the species that he may select if actual trial proves that they do not survive under his conditions.

SIZE OF PLANTING STOCK

For shelter-belt planting, younger and smaller trees than are used for ornamental or shade-tree plantings are desirable. For the broadleaf or deciduous species, seedlings 1 or 2 years old and from 1 to 2 feet high or 1-year-old rooted cuttings make the best stock. For conifer or evergreen species transplants 6 to 12 inches high should

be used. The following ages and sizes are recommended for the more commonly used species:

Siberian pea-tree, green ash, and American elm, 2-year-old seedlings, 12 to 24 inches high. Boxelder and Russian-olive, 1-year-old seedlings, 12 to 24 inches high. Northwest poplar and cottonwood, 1-year-old rooted cuttings with tops cut back so as to be 6 inches high. Black Hills spruce, white spruce, and Colorado spruce, transplants, 5 or 6 years old from seed, 6 to 12 inches high. Scotch pine, jack pine, and western yellow pine, transplants, 3 or 4 years old from seed, 6 to 12 inches high.

It is advisable to procure about 10 per cent more trees of each kind than are actually needed to make the planting. The extra trees will allow for discarding any injured or undersized ones and will provide a small stock that can be temporarily planted in a garden or other suitable piece of ground and be used to replace losses in the permanent planting the first year.

PREPARATION OF LAND FOR TREES

Under Great Plains conditions, trees have a fair chance of success only when planted in moist soil that is free from sod and weeds. The best tillage method to put land in this condition is summer fallow. Land on which a shelter belt is to be planted should, therefore, be summer fallowed the year before the trees are to be set out. If land is in sod it may take two years of summer fallow to put it into suitable condition.

The purposes of summer fallowing land in preparation for tree planting are (1) to work down the soil into a smooth, firm condition and to kill out all grass and weeds and (2) to keep the surface of the soil in a rough or ridged condition so that it may readily absorb as much as possible of the season's rainfall.

RULES FOR SUMMER FALLOW

Plow the land in the spring to a depth of 6 to 8 inches. This should be done not later than the first of June. As soon as the plowing is completed go over the ground once or twice with a harrow.

Cultivate the land as often as necessary during the summer to keep it free from weeds. It may also be advisable to cultivate after each extremely heavy rainfall that leaves the surface in a hard, packed condition.

Use a shovel or duck-foot type of cultivator in preference to a disk or harrow for working the land during the summer. The shovel type of implement leaves the surface in the best condition for soaking up rainfall and preventing soil blowing.

Give the land one cultivation in the late fall to destroy late weeds and leave the surface in a rough or ridged condition over the winter. Do not plow the land in the spring before planting, as a firm, well-settled soil is desirable for planting trees.

FENCING

Before the trees are planted, a fence that will keep out all classes of livestock should be provided. Rabbit-proof woven wire makes the best type of fence for this purpose.

METHODS OF PLANTING TREES

TIME OF PLANTING

Tree planting in the Great Plains area should be done in the spring. The planting season begins as soon as the frost is out of the ground and usually lasts for about four weeks.

Fall planting of trees is a successful practice in many regions, but on the Great Plains the fall season usually is dry, and the soil is subjected to a certain amount of heaving and cracking during the winter. This makes the fall season a much less favorable time than the spring for planting small trees.

If trees are received from the nursery in the fall, they should be carefully heeled in and not planted until spring.

CARE OF TREES BEFORE PLANTING

WETTING DOWN AND TEMPORARY STORAGE

Although trees that are obtained from a nursery are usually packed so that they will keep in the bundle for a period of a week to 10 days, they should be taken to the farm and unpacked as soon as possible. Unwrap the shipment in some cool, protected place and thoroughly wet the roots. If planting is to start at once, the trees may be kept for a short time by wetting down the packing material and re-packing it about the roots. A cool cellar or barn is a suitable place to keep trees stored in this way. If the trees must be kept for a week or more, they should be heeled in.

HEELING IN

To heel in trees, dig a trench the width of an ordinary plow furrow and about a foot deep, with one side sloping. The dirt from the trench may be placed along the sloping side to increase its height. Lay the trees against the sloping side, roots resting in the bottom of the trench, tops pointing up the slope, as shown in Figure 4. Fill dirt against the trees so as to cover completely the roots and a portion of the tops, packing it well. Small bunches of trees that can easily be held in one hand may be heeled in without being opened. If the trees come tied in large bundles, these should be cut open so that they may be spread out to allow the soil to pack more closely about each tree. If the soil is at all dry it should be well soaked with water after the heeling in is completed.

Trees will keep better if heeled in in a cool, shaded location than if placed where they will be exposed to the warm rays of the sun. It should be remembered that heeling in is a method of temporary storage. When the trees show signs of starting to send out leaves they must be planted without delay.

PLANTING THE TREES

Trees should be planted as soon as possible after being received. Endeavor to have the planting completed before they show any signs of starting to send out leaves.

The position of the rows as given in the planting plan should first be marked on the ground. Set stakes, stretch a string, or use any

other practical method that will insure straight, accurately spaced rows. The principal implement for planting trees of the size recommended is the spade. Some persons use only a spade or a shovel for digging the holes. Others first plow a deep furrow the length of the row and deepen or enlarge it with a spade or a shovel at the points where the trees are to be set. The furrows are filled in after the planting has been completed. Whatever method is used for digging the holes, the following fundamental principles should be observed: (1) Keep the roots of the trees moist by carrying them in a pail of water or wrapped in a wet sack; (2) make the holes wide and deep enough to allow the roots to be spread naturally; (3) set the tree a little deeper than it stood in the nursery; (4) pack the soil firmly about the roots. Firming the soil should begin when the hole is

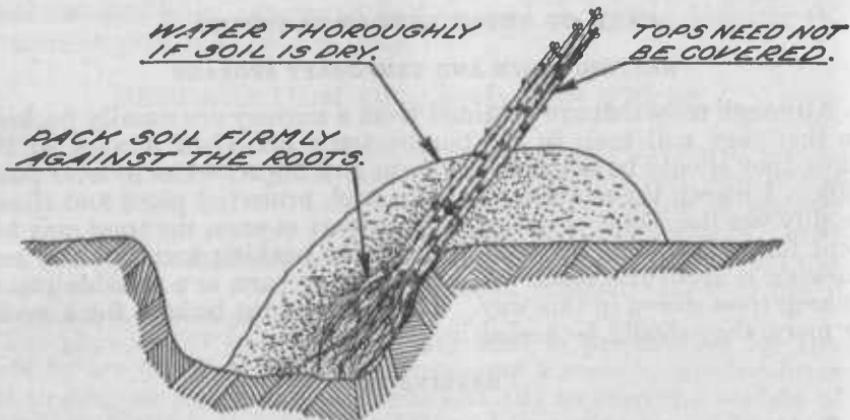


FIGURE 4.—Planting in small bunch of trees

partly filled and should continue until the filling is completed. When a tree is properly planted it should not be possible to move it with a fairly strong pull of the hand. Correct and incorrect planting practices are shown in Figure 5.

CULTIVATION AND PROTECTION OF TREES AFTER PLANTING

CULTIVATION

Control of weeds is the primary problem in the care of trees on the Great Plains. The most important operation in this connection is clean cultivation. Grass and weeds are perhaps the worst enemies of young trees, so cultivation should be practiced for several years, or as long as it is possible to work between the trees. Cultivation can be done for the most part with horse-drawn implements, but when the trees are very small weeds that are missed by the horse-drawn cultivator should be taken out with a hoe. If summer fallow has been effectively carried out so that the soil is free from weeds at the time of planting, the minimum amount of labor will be needed to keep the shelter belt clean.

The mulching of trees with straw or manure as a substitute for cultivation has been tested, but the results do not warrant the recom-

imendation of this practiee. In addition to the fact that mulehing gives little evidenec of beneficial effets, certain harmful conditions have been observed, such as furnishing harbors for mice, introducing weed seeds, increasing the fire danger, and preventing light rainfall from reaching the soil.

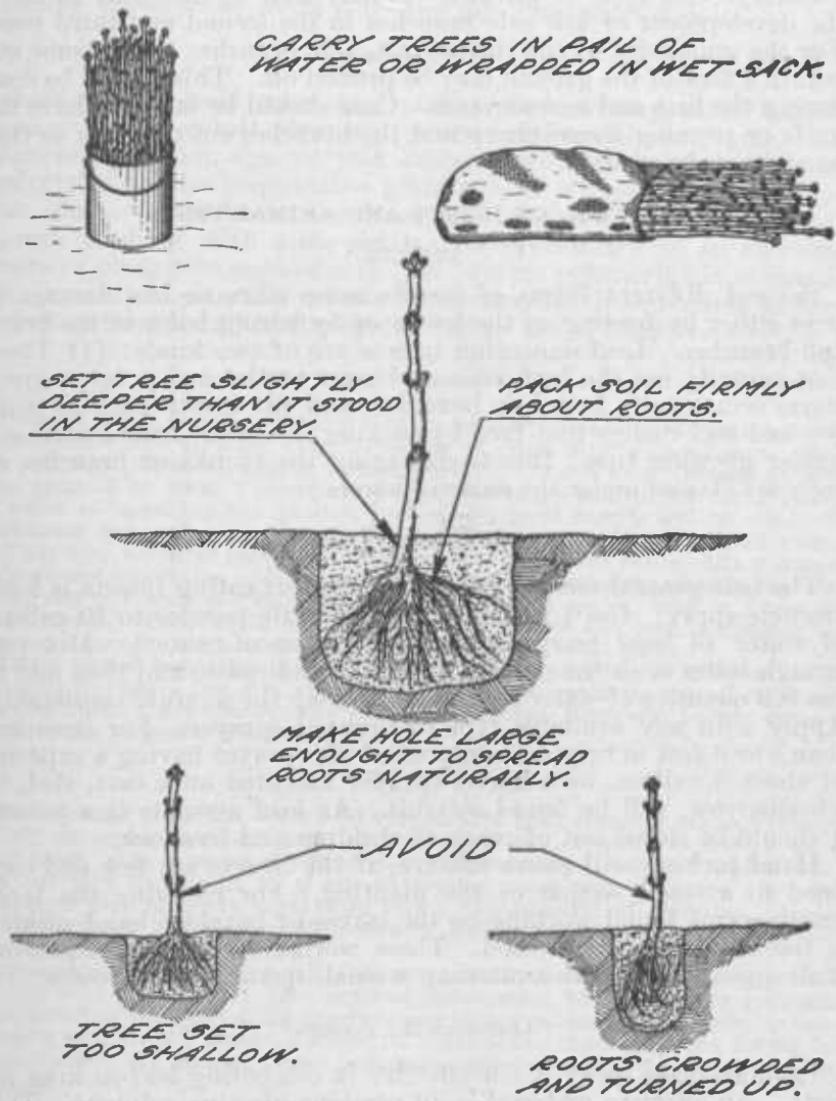


FIGURE 5.—Correct and incorrect practices in planting trees

PRUNING

Pruning has a limited application to the shelter belt, but unless it is done intelligently it is probably best to do no pruning whatever. The practiee of trimming the banches to a height of 5 or 6 feet is distinctly detrimental. The beneficial effects of pruning are con-

fined to such early trimming out of branches close to the ground as will assure to the tree a single central trunk. The need for this type of pruning will vary with the different species of trees.

With such trees as Siberian pea-tree in the outside row, branching close to the ground is desirable, and the tops should be cut back to encourage this type of growth. It may also be desirable to allow the development of low side branches in the second and third rows. For the remainder of the shelter belt, side branches which come out within a foot of the ground may be pruned off. This should be done during the first and second years. Care should be taken to have the knife or pruning shears sharp and the branches cut off clean so that no short stubs are left.

CONTROL OF INSECT AND ANIMAL PESTS

INSECTS

Several different forms of insects cause more or less damage to trees either by feeding on the leaves or by boring holes in the trunk and branches. Leaf-damaging insects are of two kinds: (1) Those that actually eat the leaf, such as blister beetles and a large green worm occasionally found on boxelder; and (2) insects such as plant lice and leaf curlers that feed by sucking the juices from leaves and tender growing tips. Insects damaging the trunks or branches of trees are classed under the name of borers.

LEAF-EATING INSECTS

The best general method of control for leaf-eating insects is lead-arsenate spray. Use 1 pound of lead arsenate powder to 50 gallons of water (3 level teaspoonsfuls to 1 gallon of water). Mix just enough water with the powder to form a thin paste and then add to the full quantity of water required, churning the mixture thoroughly. Apply with any available type of orchard sprayer. For trees less than 5 or 6 feet in height a compressed-air sprayer having a capacity of about 3 gallons, or a barrel sprayer mounted on a cart, sled, or wheelbarrow, will be found suitable. As lead arsenate is a poison, it should be stored out of reach of children and livestock.

Hand picking will prove effective if the insects are few and confined to a small section of the planting. For checking the large green worms found working on the leaves of boxelder hand picking is the only effective method. These worms are quickly destroyed if dropped into a pail containing a small quantity of kerosene.

LEAF-SUCKING INSECTS

Lead-arsenate spray is not effective in combating leaf-sucking insects. An effective material is 40 per cent nicotine sulphate. This liquid should be mixed with water at the rate of one-half pint (1 cup) to 50 gallons of water (3 teaspoonsfuls to 3 gallons of water). Add two or three bars of soap previously dissolved in water to the 50-gallon mixture, or 3 ounces to the 3-gallon mixture, and apply with an orchard sprayer.

BORERS

Borers can not be controlled by spraying. Sound trees are less liable to attack than injured trees. For this reason, if borers are found working on any species of tree, the spread of the infestation may be checked by trimming smoothly all scars or wounds and painting the exposed wood with any good waterproof paint.

RODENTS

Jack rabbits, field mice, and pocket gophers may cause serious damage to shelter-belt plantings on the northern Great Plains. An effective protection against jack rabbits, which have been the most destructive in the cooperative plantings, is a rabbit-proof woven-wire fence. Encircling the bases of trees with woven wire of $\frac{1}{4}$ -inch mesh or with some similar form of guard is an effective means of protection against mice, but is more practicable in orchards than in shelter belts. Directions for destroying these rodents as furnished by the Bureau of Biological Survey are as follows:

JACK RABBITS

Poisoned alfalfa leaves.—Dissolve 1 ounce of strichnine sulphate in 2 gallons of hot water and sprinkle over 12 pounds of clean alfalfa hay leaves. Mix the poisoned leaves thoroughly until all moisture is absorbed. Should strichnine alkaloid be used, 1 quart of vinegar should be substituted for 1 quart of water in preparing the solution, and equally good results will be obtained.

Poisoned oats.—Mix 1 tablespoonful of starch in one-half cup of cold water and stir into 1 pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strichnine with 1 ounce of powdered bicarbonate of soda (baking soda) and stir with the starch to a smooth creamy mass. Stir in 1 teacup of table salt. Apply to 12 quarts of good clean oats and mix thoroughly to coat each kernel. Each quart should make from 25 to 30 baits.

The poisoned baits should be distributed in the evening by placing small handfuls in lines a few feet apart along the rabbit runways. If all baits remaining uneaten are removed the following morning, there will be less danger of poisoning domestic livestock.

FIELD MICE

Starch-coated grain bait.—Mix 1 tablespoonful of gloss starch in one-half teacup of cold water and stir into three-fourths pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strichnine with 1 ounce of baking soda and stir into the starch to a smooth creamy mass free of lumps. Stir in one-fourth pint of heavy corn syrup and 1 tablespoonful of glycerine. Apply to 12 quarts of wheat or to 20 quarts of steam-crushed whole oats and mix thoroughly to coat each kernel.

Steam-crushed whole oats are preferable, as they may be distributed promiscuously over the infested area without endangering bird life. The poisoned bait should be scattered along runways and within entrances of burrows, a teaspoonful at a place. Wheat, however, in order not to endanger birds, should be placed inside the mouse tunnel openings, under dense cover, or in poison stations.

POCKET GOPHERS

Pocket gophers are readily caught in any one of several makes of special traps commonly on the market. For ridding alfalfa fields, orchards, and long stretches of ditch embankments of them, a very successful and much more practical method is to poison them by use of baits of vegetables, or by using poisoned grain. Either the vegetable

or the grain bait gives excellent results, but about one pocket gopher out of ten will not eat a poisoned bait, and these individuals must be trapped.

Vegetable baits.—Cut carrots, sweet potatoes, or parsnips into pieces about 2 inches long and one-half inch square, and wash and drain. From a pepper box slowly sift one-eighth ounce of powdered strychnine (alkaloid) and one-tenth ounce of saccharin (ground together in a mortar) over about 4 quarts of the dampened baits, stirring to distribute the poison evenly.

Grain baits.—Dissolve 1 heaping teaspoonful of dry glass starch in a little cold water and add to three-fourths pint of hot water. Boil, stirring constantly until a thin clear paste is formed. Mix together 1 ounce of powdered strychnine (alkaloid) and 1 ounce of baking soda, sift into the hot starch paste, and stir thoroughly to a smooth creamy mass. Add one-fourth pint corn sirup, 1 tablespoonful glycerine, and one-tenth ounce saccharin, and stir well. Pour this mixture over 13 quarts of oats, rolled barley, milo, or feterita, and mix thoroughly so that each kernel is evenly coated. Allow it to dry before it is used. (It is important that only the best grade of thoroughly clean grain be used, as chaff absorbs and wastes much valuable strychnine, and poisoned weed seeds imperil useful bird life.)

The runways, which are usually 4 to 8 inches beneath the surface, can be located by means of a probe made of any strong handle 1 inch in diameter and 36 inches long. One end should be bluntly pointed. Into the other end should be fitted a piece of $\frac{1}{4}$ -inch iron rod, protruding about 15 inches and bluntly pointed. A foot rest aids in probing hard soils. By forcing down the iron rod near pocket-gopher workings, or a foot or two back of fresh mounds, the open tunnel can be felt as the point breaks into it. The blunt end of the instrument is then used carefully to enlarge the hole, and a vegetable bait or two, or a tablespoonful of grain bait, is dropped into the run, and the probe hole closed. If a shovel is used instead of a probe to locate the runways, care should be taken not to disturb the runway more than necessary. Close the hole made so as to keep out the light, taking care that loose dirt does not fall upon the baits placed in the runway.

DOMESTIC LIVESTOCK

Horses, cattle, sheep, and hogs may do great damage to a planting of trees and should be kept out of the shelter belt by a stock-tight fence.

Should any serious infestation of insect or other pests occur, it is well to consult the State agricultural college or the United States Department of Agriculture for specific recommendations for control.

SUMMARY

The first step in establishing a shelter-belt planting is to make a drawing or planting plan showing details of the proposed planting.

Shelter for buildings and yards should be placed with the idea of winter protection. Shelter for orchards and gardens should be placed in the path of strong spring and summer winds; winter protection is of secondary importance.

Trees in a shelter belt may be placed from 4 to 6 feet apart in the row, and the rows should be from 8 to 12 feet apart. Caragana and other hedgelike types of trees should be spaced 3 feet apart in the row when planted on the edge of a shelter belt.

Two or more kinds of trees in combination give better results than the planting of only one kind. Green ash, American elm, boxelder, Siberian pea-tree, Albertiana or Black Hills spruce, and western yellow pine are some of the important species for planting on the northern Great Plains.

Well-grown seedlings 1 or 2 years old and 12 to 24 inches high are the best size of planting stock of the broadleaf types of trees. For evergreen stock transplants 6 to 12 inches high should be used.

Preparation of the soil before planting is necessary to eliminate grass and weeds and to store moisture in the soil. Clean summer fallow is the best tillage method to prepare land for tree planting.

Plant trees in the spring. Set them so that none of the root area is exposed, and pack the soil firmly about the roots. Protect the roots from drying during the planting operation.

Cultivation should be continuous during the early age of a planting, or as long as horse-drawn implements can be driven between the rows. Mulching with straw or manure is not a satisfactory substitute for clean cultivation.

It is permissible to prune off side branches near the ground, but to trim off the branches to a height of 5 or 6 feet is decidedly detrimental to a shelter-belt planting.

Tree plantings should be fenced to exclude domestic livestock. Woven wire that will keep out rabbits is the best type of fence. Trees also require protection from damage by insects and fire.

A strip of ground the full width of the distance between the rows should be cultivated along the edges of the planting.

ORGANIZATION OF THE
UNITED STATES DEPARTMENT OF AGRICULTURE

August 5, 1929

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